



Tactical operations center in combat: a case study on influence diagrams in the field of military science

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Abstract

We present an influence diagram model of a tactical operations center on a field of battle in the context of a two-party conflict. With this example, we emphasize the potential of influence diagrams in situation assessment and decision analysis, and provide viable node structures to be implemented in more complex networks.

Introduction

Analyzing decision-making always involves addressing uncertainty. The Bayesian probabilistic approach is widely favored partly due to the applicability of results of probability, partly due to the subjective interpretation of Bayesian probability suiting the uncertainty under which the decision maker acts. An application, Bayesian networking, is a form of graphical representation of stochastic dependence between observables and factors, encoding these random variables into the chance nodes and conditional dependencies of their distributions into the arcs of a directed acyclic graph. Influence diagrams expand the notion of graphical dependency representation by including non-stochastic decision variable nodes in the graph structure. The instantiations of decision nodes are called alternatives, in contrast to those of chance nodes being called states. This effectively leads to the model recommending which actions the decision-maker should make based on the notion of preferability of utility theory. Thus it has sparked the interest of military organizations since the turn of the century.

Tactical Operations Center (TOC)

The battalion commander, together with his subordinates, is set to a location from where he leads the battle. This location, be it founded either on existing infrastructure or out in the field, is known as the tactical operations center (abbr. TOC) for the battalion. The terrain surrounding the TOC must provide sufficient cover, without sacrificing vehicle mobility. Furthermore, the terrain must not inhibit connecting the TOC to the existing communications network frame of the battalion. However, the radio links are to be positioned so that the damage to the communications network due to direct and indirect fire is mitigated as much as possible.

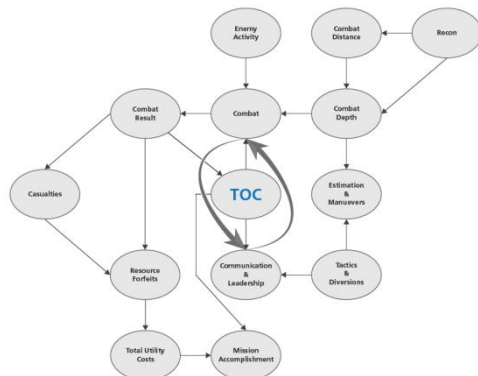


Figure 1. An illustration of the functioning of the TOC.

Modelling TOC

In this paper, we present a model influence diagram applied to the context of military science. The scenario prototype used in this model considers the survival of a tactical control center

(TOC) in a two-party conflict. The aim of the network is to provide a tool for decision making by providing exemplative node structures to be implemented in more complex networks. The remainder of the paper is organized as follows: first, the section Model basis discusses the scenario to be modeled for both examined parties. Then, the section Diagram structure gives the outlines of the engineering of our model diagram, and introduces a brief summary of the effectiveness of algorithms on the network.

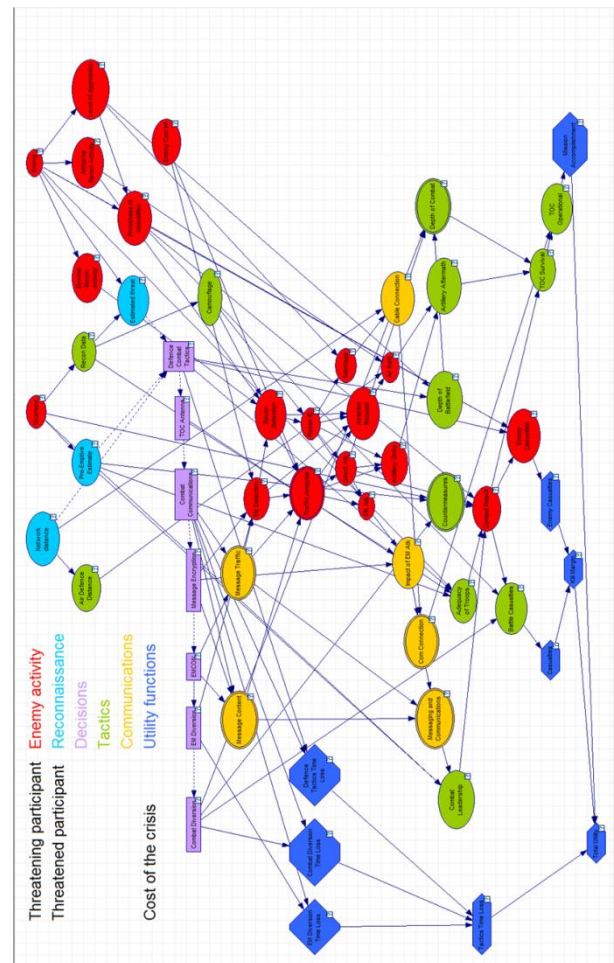


Figure 2. A detailed model of the TOC.

Conclusions

We structured a military conflict scenario into an influence diagram. In the model, we presented an instantiation of a noisy-MAX distribution and a decision inhibition structure, and introduced the implementing of auxiliary linguistic nodes. We found affirmative evidence on the ineffectiveness of sampling-based solution algorithms on diagrams with a fairly simple chance node structure. As an extension of our model, we aim to develop efficient methods for applying network-wise sensitivity analysis.

